

# The Foraminiferal Genus *Cruciloculina* d'Orbigny, 1839

By Alfred R. Loeblich, Jr., and Helen Tappan<sup>1</sup>

## Introduction

THE GENUS *Cruciloculina* was described in 1839, and d'Orbigny (1839b) later recorded a single species, *C. triangularis*. Later workers did not recognize this genus, however, considering it a synonym of *Triloculina* d'Orbigny, in spite of the distinctive cruciform aperture. A century later Asano (1949, p. 479) made a detailed study of the apertural development of a second species, *Cruciloculina japonica*, and emended the generic diagnosis. The type species for the genus was from the Recent seas off the Falkland Islands, and the species described by Asano was from the Pliocene of Japan.

During the course of generic studies of Foraminifera for the "Treatise on Invertebrate Paleontology," the writers examined d'Orbigny's types of *Cruciloculina* in the Museum National d'Histoire Naturelle in Paris. A lectotype for this species is here selected, refigured, and described. An additional topotype specimen of *C. triangularis* has also been illustrated.

A topotype specimen of *C. japonica* Asano from the Japanese Pliocene is illustrated and a brief description given for comparison.

Three new Recent species of the genus are also here described, two occurring in the Caribbean and the other in the North Atlantic off southwestern Ireland.

The ontogenetic apertural development of all species is similar to that described by Asano for *C. japonica*.

The genus is thus fairly widespread in the Recent seas, and in the future will probably be found more widespread in fossil faunas as well.

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Grateful acknowledgment is given of the cooperation of M. Jean Roger, Museum National d'Histoire Naturelle, Paris, France, in permitting the restudy and reillustration of the d'Orbigny type specimens.

We are indebted to Dr. K. Asano, Institute of Geology and Paleontology, Tohoku University, Sendai, Japan, and to Mr. T. Uchio, Institute of Petroleum Engineering, Tokyo University, Tokyo, Japan, for furnishing us an excellent series of the species *Cruciloculina japonica* Asano from Japan.

## Systematic Descriptions

### Family Miliolidae d'Orbigny, 1839

#### Genus *Cruciloculina* d'Orbigny, 1839

*Cruciloculina* D'ORBIGNY, Foraminifères in de la Sagra, Hist. Phys., Polit. et Nat. de l'île de Cuba, p. 182, 1839.

TYPE SPECIES: *Cruciloculina triangularis* d'Orbigny, 1839. Fixed by subsequent monotypy by d'Orbigny (1839b, p. 72).

Test free, chambers coiled, with the longitudinal planes of successive chambers added 120 degrees apart as in the development of *Triloculina*, test rounded to triangular in section; sutures distinct, depressed; wall calcareous, imperforate, smooth or faintly striate; aperture complex, varying in shape from triradiate in the young to cruciform or dendritic in the adult, bordered by a narrow lip, but without a distinct tooth.

*Cruciloculina* differs from *Triloculina* d'Orbigny in the apertural features, lacking the distinct tooth of *Triloculina* and developing from a simple linear, bifid or triradiate aperture in the young to a cruciform or dendritic aperture in the adult.

This genus occurs in the Pliocene of Japan and in the Recent in the North and South Atlantic and Caribbean.

*Cruciloculina asanoi* Loeblich and Tappan, new species

PLATE 74, FIGURES 8-11

Test free, triloculine in chamber development, ovate in side view, subtriangular in section, angles rounded; chambers with slight amount of overlap, so that those in the final whorl appear nearly equal in size; sutures distinct, slightly incised; wall calcareous, imperforate, surface smooth, aperture triradiate in young specimens, becoming cruciform in the adult.

Length of holotype 1.06 mm., thickness from center of final chamber to opposite angle 0.94 mm. Paratypes range from 0.51 to 1.10 mm. in length.

REMARKS: This species is similar in appearance to *C. japonica* Asano, but differs in the very slight amount of chamber overlap, somewhat smaller size, and much less complex adult aperture, that of *C. asanoi* becoming only cruciform, whereas that of *C. japonica* may become highly dendritic in appearance.

<sup>1</sup> Helen Tappan Loeblich, U. S. Geological Survey and Research Associate, Smithsonian Institution.

The species is named in honor of Dr. K. Asano, in recognition of his work on this genus, as well as the other groups of Foraminifera.

**TYPES AND OCCURRENCE:** Holotype (USNM P4880), figured paratypes (USNM P4267a-c), and unfigured paratypes (USNM P4268) from *Challenger* Station 24, lat. 18°38'30" N., long. 65°05'30" W., at 390 fathoms, in the Caribbean Sea.

*Cruciloculina ericsoni* Loeblich and Tappan, new species

PLATE 74, FIGURES 3-7

Test free, ovate in section, nearly circular in side view, chambers triloculine in arrangement, final chamber with considerable overlap of earlier chambers, the margins of the chambers with a slight flange, which leaves a groove paralleling the suture at the contact with earlier chambers; sutures distinct, slightly incised; wall calcareous, imperforate, surface smooth; aperture triradiate in young specimens, becoming cruciform to dendritic in the adult, bordered by a distinct, slightly recurving lip.

Length of holotype 1.08 mm., breadth (from center of final chamber to opposite side) 1.05 mm.

**REMARKS:** *Cruciloculina ericsoni*, new species, differs from *C. japonica* Asano in being smaller and more inflated, nearly circular in side view, and in lacking distinct angles; and in the slight chamber flange bordering the sutures. The apertural lip is also somewhat more prominent.

The species is named in honor of David Ericson in recognition of his work on deep sea cores.

**TYPES AND OCCURRENCE:** Holotype (USNM P3140) and figured paratypes (USNM P4338a-d) from F. C. *Helga* haul SR 331, southwest Ireland, lat. 51°12' N., long. 11°55' W., at a depth of 610 to 680 fathoms.

*Cruciloculina japonica* Asano, 1949

PLATE 74, FIGURE 12

*Cruciloculina japonica* ASANO, Journ. Palentol., vol. 23, no. 5, p. 480, pl. 80, figs. 1-2, 6-13, 1949.

Test free, triloculine in chamber development, sub-triangular in section with rounded angles, final chamber with considerable overlap of the earlier chambers, so that the final chamber covers nearly one-half the width when the test is viewed from the side showing the oldest of the three final chambers; sutures distinct, slightly incised; wall calcareous, imperforate, surface smooth; aperture triradiate in young specimens, then becoming cruciform and finally dendritic in adult specimens, with a narrow bordering lip.

Length of figured topotype 1.63 mm., greatest thickness, from center of last chamber to opposite angle, 1.43 mm., although the majority of specimens are somewhat smaller.

**REMARKS:** *Cruciloculina japonica* Asano differs from *C. triangularis* d'Orbigny in being slightly smaller, and much less distinctly triangular, with more convex sides and rounded angles. The aperture of *C. japonica* also tends to become more complexly dendritic.

**TYPES AND OCCURRENCE:** Figured topotype (USNM

P4339) and unfigured topotypes (USNM P3221, P4864) from the Late Pliocene Sawane formation in a sea cliff facing Mano Bay, Sawane-Machi, Sado-Gun, Niigata Prefecture, lat. 37°59'47" N., long. 138°16'43" E., Japan. Collected by T. Uchio.

Unfigured topotypes (USNM P63) from the same locality. Collected by K. Asano.

*Cruciloculina striata* Loeblich and Tappan, new species

PLATE 74, FIGURES 13-16

Test free, medium in size, robust, sides convex, subovate in section; chambers arranged as in *Triloculina*, inflated, with considerable overlap of earlier chambers; sutures distinct, flush to slightly incised; wall calcareous, imperforate, surface ornamented by numerous very fine longitudinal striae; aperture triradiate in young specimens, cruciform to dendritic in older specimens.

Length of holotype 1.04 mm., thickness from center of final chamber to opposite side 0.96 mm. Paratypes range from 0.73 to 1.09 mm. in length.

**REMARKS:** *Cruciloculina striata*, new species, is closest to *C. ericsoni*, new species, in general form, but differs in the presence of the vertical striae which are characteristic of the present species.

**TYPES AND OCCURRENCE:** Holotype (USNM P4264), figured paratypes (USNM P4265a-c), and unfigured paratypes (USNM P4266) all from *Challenger* Station 24, lat. 18°38'30" N., long. 65°05'30" W., in the Caribbean Sea at 390 fathoms.

*Cruciloculina triangularis* d'Orbigny, 1839

PLATE 74, FIGURES 1, 2

*Cruciloculina triangularis* d'ORBIGNY, Voy. dans l'Amerique Mérid., Foraminifères, p. 72, 1839.

Test free, triloculine in chamber development, triangular in section, with sides equal in breadth and flat to very slightly convex and angles acute; chambers increasing regularly in size with final chamber only moderately overlapping earlier chambers; sutures distinct, very slightly incised; wall calcareous, imperforate, surface smooth; aperture typically cruciform, with the extremities tending to become dendritic in larger specimens, bordered with a narrow lip.

Length of lectotype 1.28 mm., greatest thickness (from center of final chamber to opposite angle) 1.13 mm. The topotype here figured is 1.9 mm. in length and the breadth of the final chamber is 1.68 mm.

**REMARKS:** This species is characterized by the sharply triangular section, large size, and relatively simple cruciform aperture.

**TYPES AND OCCURRENCE:** Lectotype (here designated and figured) of *C. triangularis* d'Orbigny in the Museum National d'Histoire Naturelle, Paris, France, from Recent dredgings near the Falkland Islands. Figured topotype (USNM P4520) and unfigured topotypes (USNM P4521) from R. R. S. *Discovery* Station 144, from lat. 54°04' S., long. 36°27' W., to lat. 53°58' S., long. 36°26' W., off the mouth of Stromness Harbor, depth 155-178 meters, South Georgia.

## References

ASANO, K.

1949. The foraminiferal genus *Cruciloculina* d'Orbigny, 1839. Journ. Paleontol., vol 23, No. 5, pp. 479-480, pl. 80.

D'ORBIGNY, A.

- 1839a. Foraminifères, in de la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, pp. 1-224, pls. 1-12.
- 1839b. Foraminifères. Voyage dans l'Amérique méridionale, vol. 5, pt. 5, pp. 1-86, pls. 1-9.